

SECTION 15800

AIR DISTRIBUTION

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A.** Work Included: This Section specifies ductwork and accessories for air distribution system, including testing and balancing.
- B.** Related work. This will include section 15250-Insulation.

1.2 REFERENCES

- A.** ADC - Air Diffusion Council
- B.** ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
- C.** SMACNA - Sheet Metal and Air Conditioning Contractors National Association, Inc.

1.3 SUBMITTALS

- A.** Qualifications for Balancing and Testing: Submit materials as required complying with requirements of Part 1 "Quality Control" Article.
- B.** Test Reports of Air Balancing
 - 1. General: Submit three copies of complete air balance report certified by registered professional engineer. Include data for each system balanced as listed below.
 - 2. Air Balance, Air Handling Equipment, and Unit Equipment
 - a. Installed:
 - 1) Manufacturer of fans
 - 2) Size
 - 3) Arrangement, discharge, class
 - 4) Motor, hp, volts, phase, full load amps
 - b. Design Conditions:
 - 1) CFM
 - 2) Static Pressure at Fan Discharge
 - 3) Motor hp
 - 4) Percent fresh air
 - 5) Fan rpm
 - 6) Fan motor bhp
 - c. Field Test Results:
 - 1) CFM
 - 2) Static pressure at fan discharge

- 3) Fan rpm
 - 4) Fan operating amps
 - 5) Fan motor operating bhp
- 3. Velocity Tests for Main and Branch Ducts:
 - a. Duct size:
 - 1) Number of velocity readings
 - 2) Duct average velocity
 - 3) Total cfm
- 4. Supply and Return Air Grilles:
 - a. Outlet and inlet identification (location and number designation)
 - b. Manufacturer and type
 - c. Effective face area factor, core area or neck area
 - d. Required and resultant test velocities
 - e. Required and resultant test quantities in cfm
 - f. Deflector settings

1.4 QUALITY CONTROL

- A. Performance Requirements: Provide air supply devices complying with following:
 - 1. ADC Standard 1062R4, "Certification Rating and Test Manual"
 - 2. ASHRAE Standard 36B, "Method of Testing for Rating the Acoustic Performance of Air Control and Terminal Devices"
- B. Design Criteria
 - 1. Provide weather louvers and louvered penthouses:
 - a. Designed to conform to wind pressures and seismic requirements as specified in the Construction Specifications.
 - b. Designed to remain weatherproof when subjected to design wind pressures.
- C. Balancing and Testing Qualifications and Requirements
 - 1. Notification Point. Conduct balancing under supervision of qualified registered professional engineer or independent qualified agency which specializes in balancing of air systems. Submit name of registered professional engineer or balancing agency with their qualifying experience for acceptance by the Engineer.
 - 2. Conduct testing and balancing in presence of the Engineer or his authorized representative. Notify Engineer at least fourteen days in advance of proposed time of conducting this work so that mutually agreeable time can be arranged.

PART 2 - PRODUCTS

2.1 GENERAL

- A.** Basic materials for mechanical work are specified under Section 15050 - BASIC MATERIALS AND METHODS FOR MECHANICAL WORK.

2.2 MATERIALS

A. Galvanized Steel

1. Steel Sheets No. 14 Gauge or Lighter: ASTM A653, coating designation G 90.
2. Steel Heavier Than No. 14 Gauge: ASTM A36, hot-dip galvanized after fabrication in accordance with ASTM A123, A153 and A386, as applicable.

B. Steel Shapes, Angles and Rods

1. For Ductwork Supports: Conform to ASTM A36 hot-dip galvanized in accordance with ASTM A123, Coating Designation G 90.
2. Hardware for Supporting Ductwork: Galvanized in accordance with ASTM A153.

C. Aluminum Extruded Shapes and Bars; Sheet and Plate: ASTM B221 and B209 alloys as required for finish and color indicated complying with applicable requirements of Section 05500 - MISCELLANEOUS METALS. Provide anodized or fluorocarbon finish as specified in the Construction Specifications, color as indicated.

D. Screen Material: Maximum 1/2 inch mesh, 0.80 inch diameter aluminum wire, intercrimped bird screen.

E. Sealants: Conform to requirements of Duct Manual, Chapter 4.

2.3 FABRICATION

A. Ductwork

1. Duct construction detail and metal gauges shall conform to SMACNA, Low Velocity Duct Construction Standards, referred to herein as the Duct Manual, except where necessary to increase gauges and supports for structural strength or other particular needs. Provide electrical isolation between dissimilar metals.
2. Round Ductwork. Construct round ducts of galvanized steel in accordance with Duct Manual without turning vanes. Provide long radius sectional type elbows unless otherwise accepted.
3. Rectangular Ductwork. Construct rectangular Ductwork in accordance with Duct Manual. Single thickness vanes will not be accepted. Construct fittings in accordance with Duct Manual. Exposed ductwork

at ceiling of station platform areas shall have no longitudinal seams at bottom of duct or bottom corners. Also, transverse seams shall be drive slip with no raw edges at bottom of duct.

4. No internal ductwork insulation will be accepted.

- B.** Hangers and Supporting System: Construct hangers and supporting system in accordance with Duct Manual. For exposed station platform area ducts use strap hangers and round off ends of exposed straps.
- C.** Duct Plenums: Field fabricate plenums with metal, gauges, reinforcing and construction in accordance with Duct Manual, except where otherwise shown on the Contract Drawings. Caulk joints.
- D.** Access Doors
 - 1. Size access doors to plenums as indicated and construct in accordance with Duct Manual. Provide doors with a minimum of two hinges and two cam locking type latches, operable from both outside and inside.
 - 2. Provide access doors in ducts, where required to gain access to resistance heaters, dampers, filters, coils or controls. Doors shall be gasketed and secured to duct with sheet metal screws. Construct in accordance with Duct Manual.
- E.** Ducts to be Embedded in Concrete: Fabricate ducts of galvanized steel minimum 1/4 inch thick, welded in accordance with AWS D1.1.

2.4 MANUFACTURED PRODUCTS

- A.** Instrument Test Holes. Provide instrument test holds with factor fabricated tight, non-corrosive screw cap and gasket. Cap shall be raised up through insulation.
- B.** Air Extractors. Provide air extractors for registers and grilles in accordance with Duct Manual.
- C.** Dampers
 - 1. General: Provide blades for splitter, butterfly, and opposed blade dampers of the same metal as the ductwork and casings, except two gauge numbers heavier. Provide necessary ductwork accessories for fastening dampers to ductwork. Additionally, provide dampers having accessible operating mechanisms.
 - 2. Manually Operated Volume Dampers and Splitters:
 - c. Provide dampers in ducts where indicated and where required for proper balancing of the various air systems. Dampers shall be fabricated in accordance with Duct Manual. Multiple blades shall be not over six inches wide and shall be gang operated.

- Provide factory fabricated dampers with non-metallic edges or coating.
- d. Provide dampers with shafts and bearings so designed and mounted that the position of the damper within the duct shall be clearly indicated from the outside of the duct, and the exposed portion of the actuating mechanism of the damper can be manually operated without the use of special tools. On insulated ducts the damper operator and indicator shall extend beyond the insulation and covering.
3. Automatic Dampers: Provide factory fabricated automatic dampers where indicated. At all points where the dampers come in contact with outside air, they shall be of airtight construction and shall be felted. Provide modulating dampers having opposed blades; two position dampers having parallel blades; unless otherwise specified in the Construction Specifications. Self-lubricated bearings shall be provided. Damper operators shall be externally mounted; unless otherwise specified in the Construction Specifications.
4. Back Draft Dampers: Provide factory fabricated back draft dampers of the counter-balanced automatic construction. Blade linkage shall be located outside the air stream and shall be of galvanized steel. Axles shall be 3/16 inch diameter rod steel with a maximum panel width of 30 inches. Bearings shall be oil impregnated bronze. Provide blades with felt cushions to insure adequate sealing.
5. Fire Dampers
- a. Provide factory fabricated fire dampers with fusible links in ducts where indicated and as otherwise required by National, State and Local Fire Codes and all other local agencies having jurisdiction. Provide fusible links rated at 160°F. Damper construction and installation shall conform to NFPA Bulletin No. 90A. Access doors shall be provided to allow replacement of fusible links and resetting of fire dampers. Closely fit damper blades to inside duct dimensions and mount on corrosion-resisting bearings. Hold blades in open position by chain and fusible link of the designated melting point. Arrange dampers to closely position against an angle stop. Provide steel spring catch to hold damper closed and a radius arm on start to show damper position.
 - b. Construct multi-louvered dampers of linked blades of not less than No. 18 USS gauge with a maximum single blade dimension of 6 inches by 24 inches. Stiffen blades by formed edge. Blades shall overlap one inch when closed. Mount fire dampers within a structural steel channel iron frame connected to the duct at each end by an airtight welded or riveted joint.
 - a. Locate fusible link, steel spring catch and access door on downstream side of damper wherever access to damper for testing purposes is not possible from upstream side. Locate fusible link a maximum of six inches from the top or bottom of the access door depending on the location of the damper.

- b. Maximum allowable pressure drop through fire dampers shall not exceed 0.10 inch water gauge at 2000 fpm velocity when the damper is in opened position.
- D. Air Outlets and Inlets: Unless otherwise specified herein or indicated, provide factory finishes for items exposed to public view of C54 or C55 medium statuary bronze as specified in the NAAMM Metal Finishes Manual, and equal to BHMA 613 finish; provide factory finishes for items not exposed to public view of ANSI F55.1, Color Chip 61. Protect outlets and inlets within seven feet of the floor level with a debris screen of heavy duty construction behind face through which a half-inch sphere will not pass and to resist physical abuse.
- E. Air Diffusers
 - 1. General
 - a. Provide diffusers of the circular, square, rectangular or linear type as indicated. The type of ceiling construction where the diffuser is to be installed shall determine the type of compatible diffuser ring or frame to be provided. Equip diffusers with baffles or other devices required to provide the air distribution pattern that will meet the specified performance. Provide factory fabricated turning vanes, furnished by the diffuser manufacturer, at each diffuser. Provide each diffuser with a factory fabricated single key, opposed blade volume damper.
 - b. Construct diffusers of steel or aluminum with all edges exposed to view rolled or otherwise stiffened and rounded. Internal parts of each diffuser shall be removable as a unit to permit cleaning of the diffuser and to provide access to the ducts. Construct removable parts so they cannot be reassembled in any manner that will produce an incorrect air distribution pattern. The internal assembly shall be fastened so it can be removed and reassembled without special tools. Provide ceiling diffusers having airtight felt, neoprene, or plastic sealing strips at edges, to prevent air leakage.
 - 2. Circular, Square and Rectangular Diffusers: Each circular ceiling diffuser shall consist of two or more concentric circular elements designed to deliver air radially, in a generally horizontal direction, without excess smudging of the ceiling. Square and rectangular ceiling diffusers shall be generally similar to circular diffusers, except that outer elements shall be square or rectangular and interior elements may be circular, or rectangular as required to provide a suitable distribution pattern.
 - 3. Linear Air Diffusers
 - a. Provide linear air diffusers of the size and capacity indicated. Joints between diffuser sections shall appear as hairline cracks. Provide diffusers with alignment slots for insertion of key strips

or with other concealed means to align all exposed butt edges of diffuser. Corner joints of frames, and flanges exposed below ceiling or side wall shall appear as hairline cracks with unexposed sides of corner joints welded or secured with alignment keys.

- b. Air delivery patterns shall be manually adjustable from the face of the diffuser, to provide a full 180° air pattern, from horizontal left or right, vertical or intermediate pattern from each slot independent of any other slot. The diffuser shall have damper blades which are independent of pattern blades and which shall be manually adjustable from the face of the diffuser to provide an integral volume control for active sections to complete blank-off of inactive sections.
- c. Construct diffusers and component parts of extruded aluminum and finish as accepted by the Engineer. Do not use screws, bolts, and other items in exposed face of diffusers' frames or flanges.

F. Registers

1. Supply Registers

- a. Supply registers shall consist of two sets of louvers. Front set of louvers shall be set parallel to the long dimension and be individually adjustable to any degree of deflection in the vertical plane. Rear set of louvers shall be set parallel to the short dimension and individually adjustable to any degree of deflection in the horizontal plane.
- b. A key operated opposed blade damper shall form an integral part of the register.
- c. Furnish and install as required for proper balancing, air volume extractor and controller, with key operated mechanism through face of register.

2. Return Registers: Return registers shall have a set of fixed blades, spaced at one-half inch center and set at 30° downward deflection. A key operated opposed blade damper shall form an integral part of the register.

3. Exhaust Registers: Exhaust registers shall have a front set of fixed blades parallel to the long dimension and set at 45° downward deflection. Rear shutoff multishutter blades shall be operated by a lever operated from the face of each register.

G. Air Grilles

1. Supply Grilles

- a. Provide supply grilles of adjustable four-way directional type having horizontal and vertical adjustment by means of individual bars or vanes spaced not over two-thirds inch apart.
- b. Provide frames of stamped or rolled steel sections having corner joints finished to provide neat, trim appearance. Additionally,

provide supply grilles with air-tight felt, neoprene, or plastic sealing strips at edges to prevent leakage.

- c. Where indicated, provide factory-fabricated multiple-blade extractors, of air deflecting type with blades spaced not over two inches apart and install in accordance with manufacturer's recommendations.
- d. Exhaust and Return Grilles: Provide grilles constructed same as supply grilles, except equipped with single set of non-directional non-adjustable, non-see-thru face bars or vanes having same appearance as supply grilles.

H. Flexible Couplings

- 1. Provide flexible coupling where indicated and at points where ductwork connects to fans.
- 2. Provide flexible coupling with factory assembled flexible material bordered on each side with three inch wide galvanized steel edging, mechanically attached.
- 3. Provide the flexible portion of 32 ounce per square yard heavy fiberglass cloth, with fire resistant neoprene coating on both sides suitable for operating temperatures of 300°F. Provide material with a tensile strength not less than 450 psi.
- 4. The unclamped section of the flexible coupling between apparatus and ductwork shall not be less than 4 inches in length, crimped to form fluted corrugations.
- 5. Closely fit and securely clamp couplings to ductwork, fans and apparatus with heavy bolted clamps to permit easy removal.
- 6. Flexible couplings shall not be painted or used to correct misalignment.

I. Electric Duct Heaters

- 1. Self-contained units designed for insertion into and connection to air duct, with heating elements directly in air stream, and having control box with contractors.
- 2. Adapt available duct heater dimensions to duct dimensions with sheet metal transformation.
- 3. Provide heaters having low pressure drop at nominal air flow rate.
- 4. Provide heaters having kW capacity and type of control indicated, open coil type with sheathed heater wires protected against corrosion, moisture and sagging.

5. Designed such that surface temperature shall not exceed 400°F during normal air flow.
6. Constructed to protect register wire from electrical and mechanical shock, vibration and breakage in shipment, installation and use.
7. Conform to requirements of UL Standard 573 and NEC.
8. Provide number of electrical circuits as indicted.
9. Provide heaters having wattages within 5% of ratings indicated.
10. Provide each heater with two high limit controls as follows: primary automatic reset thermal control wired to controlling device and secondary manual reset thermal cut-out device wired to de-energize main power. Both controls shall be used to protect elements from excess temperature due to air flow stoppage.
11. For coils subjected to high pressure, provide airtight units.
12. Provide heaters having coil complete with contractors and safety cutouts (high limits) complying with code and safety requirements, except not including temperature regulating devices.

J. Turning Vanes: Provide galvanized metal-extended single foil type.

K. Weather Louvers

1. General
 - a. Provide louvers having minimum metal thickness of blades and frames conforming to SMACNA "Architectural Sheet Metal Manual", and as indicated.
 - b. Having blades accurately fitted and firmly secured to frame.
 - c. Having edges of louver blades folded or beaded to frame to exclude driving rain.
 - d. Provide louvers with bird screen material secured within an extruded aluminum frame independent of louvers and replaceable within such frame.
 - e. Having reinforcing bosses, all welded connections with welds on visible surfaces ground smooth and flush and with surfaces free of blemishes.
 - f. Face Velocity Capacities
 - 1) Air Intake Louvers: Stormproof at 500 feet per minute minimum.
 - 2) Air Exhaust Louvers: Weatherproof at 600 feet per minute minimum.

L. Louvered Penthouses

1. Low-silhouette, product of a manufacturer normally supplying penthouses, curb mounted, with insulated factory-fabricated curbs,

dome type roof exhaust unit, equipped with waterproof top and rainproof louvers around the sides.

2. Louvers of extruded aluminum designed to provide resistance to the entry of rain while allowing minimum air resistance.
3. Provide each unit with removable roof constructed of aluminum, insulated with one-inch thick glass fiber insulation with vapor barrier attached to under side of roof.
4. Units assembled and internally braced with curb tie downs.
5. Bolts and Screws: Aluminum or stainless steel.
6. Provide screens mounted on inside of unit in removable frames of extruded aluminum or stainless steel.
7. Provide aluminum curb flashing around curbs.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General

1. Install products in accordance with accepted working and shop drawings and in accordance with the equipment and material manufacturers' instruction.
2. Conform to NFPA No. 90A and the Duct Manual for installation of equipment, ductwork, dampers and accessories.
3. Ducts, unless otherwise accepted, shall conform to the dimensions indicated and shall be straight and smooth on the inside, with joints neatly finished. Hammer down edges and slips to leave a smooth interior duct finish. Make joints substantially airtight, and no dust marks from air leaks shall show at connections, grilles, register, or diffusers.
4. Anchor ducts securely to the structural slab or framing in the building. Construct and install ducts as to be completely free from vibration under all conditions of operation. Attach supports only to structural framing members and concrete slabs. Do not anchor supports to metal decking unless a means is provided and approved for preventing the anchor from puncturing the metal decking. Where supports are required between structural framing members, provide suitable intermediate metal framing. Items not shown in detail or described herein shall be as set forth in the Duct Manual.

5. During installation, seal duct sections to prevent entry of dust and dirt. Line ducts and plenum where indicated. Line and insulate ducts in accordance with Section 15250 - INSULATION.

B. Ductwork Expansion Joints

1. Where a ductwork expansion joint crosses structural contraction or expansion joints, make the crossing at 90° to the plane of the joint. Provide slip type expansion joints in ductwork at such crossings. The expansion joints shall provide adequate accommodation for linear movement at the structural joint. Make similar provision for expansion and contraction in the design and fabrication of the perforated galvanized steel inner lining.
2. Where ductwork is connected to concrete surfaces, provide the type of connection as indicated.

C. Flexible Couplings: Install flexible couplings at fans and air handling units as indicated. Wherever ductwork will be subjected to changes in length which must be absorbed in the ductwork, install either a slip joint as specified above or a flexible coupling.

D. Access Doors: Install access doors where indicated. Use insulated doors where duct or plenums are insulated or lined.

E. Instrument Test Holes

1. Install instrument test holes where required for balancing and testing. Cap shall be raised up through insulation.
2. Location of balancing holes shall be as directed by the Engineer.

F. Duct Sleeves and Prepared Openings

1. General: Provide duct sleeves for round ducts 15 inches diameter or less passing through floors, walls, ceilings, or roofs. Provide round ducts larger than 15 inches diameter and square and rectangular ducts passing through floors, ceilings, or roofs with prepared openings. Properly size and locate sleeves and openings. Provide duct sleeves and prepared openings for duct mains and duct branches. Branch take-off connections to grilles, registers and diffusers shall be in accordance with the Duct Manual.
2. Duct Sleeves: Fabricate duct sleeves from 20 gauge galvanized steel unless otherwise indicated. Where sleeves are installed in bearing walls or partitions, use black steel pipe, schedule 30, 40, or standard weight. Sleeve shall provide one inch clearance between the duct and the sleeve except at grilles, registers and diffusers.

3. Prepared Openings: Prepared openings shall provide one inch clearance between the duct and the opening except at grilles, registers and diffusers.
4. Closure Collar: Provide closure collar of galvanized steel not less than four inches wide on each side of walls or floors where sleeves or prepared openings are provided except where grilles, registers or diffusers are installed. Install the collar tight against the surface and fit snugly around the duct. Fabricate collars for round ducts 15 inches diameter or less from 20 gauge galvanized steel. Fabricate collars for square or rectangular ducts and for round ducts with minimum dimension over 15 inches from 18 gauge galvanized steel.
5. Packing: Pack the space between the sleeve or opening and the duct with commercial twisted asbestos yarn.

G. Dampers and Splitters

1. Install dampers and splitters so they can be adjusted at any time after completion of the work.
2. Install dampers, including automatic dampers, without strain or distortion of any part of the dampers. Moving parts shall move freely without binding. Caulk around frames of all dampers.
3. Adjusting rods and locking quadrants shall operate freely, between the fully open and closed positions. After adjustment, cut off projecting ends of rods flush with the operating quadrants for all volume dampers.

H. Air Inlets and Outlets: Install air inlets and outlets in accordance with details indicated and in accordance with manufacturer's instructions. Make joints weather tight by use of gaskets or accepted sealant. Color of sealant, if used, shall match color of louver material unless otherwise accepted.

3.2 TESTING

- A.** Test ductwork prior to placement of insulation. Test all ductwork with an internal air pressure test, pressure for such test shall be the maximum pressure designated in the Duct Manual for low velocity ducts. Test all joints and seams in the presence of the Engineer, while maintaining the above pressure. No leakage shall be noticeable through the senses of feeling or hearing at any joint or connection.

3.3 BALANCING AND TESTING

A. General

1. After completion of the installation of the air distribution systems and prior to acceptance, adjust air handling systems and appurtenances

applicable to those systems and balance to deliver the air quantities as indicated. This includes all fans whether connected to sheet metal duct work or not.

2. Instruments required for air balance shall have been calibrated within a period of six months prior to use for the work under the Contract. Types, serial numbers, and dates of calibration reports shall be as hereinafter specified.

B. Air Balance

1. Perform air quantity measurements in main and branch ducts by pitot tube traverse of the entire cross-sectional area of the duct. Measure ducts having velocities of 1,000 fpm or more, by inclined manometers (draft gauge) magnehelic gauges. Perform air measurements required for ducts having velocities of less than 1,000 fpm with micro-manometers, hook gauges or similar low pressure instruments. Seal openings in ducts for pitot tube insertion with snap-in plugs after air balance is completed. Determine outlet and inlet air quantities by direct reading velocity meters in accordance with the register and grille manufacturer's recommendation.
2. Obtain total air quantities by adjustment of fan speeds or blade settings. Adjust branch duct air quantities by volume or splitter dampers. Permanently mark damper operators after air balance is complete so that they can be restored to their correct position if disturbed at any time. Maintain highest possible fan efficiency during balancing.
3. Volume dampers may be used to balance air quantities at outlets and inlets providing final adjustments do not produce objectionable sound levels or drafts. Air quantity adjustment by outlet deflectors, grids, or air scoops will not be permitted.

- C.** Test Reports of Air Balancing: Record and submit to the Engineer, for evaluation and acceptance reports complying with requirements of this Section.

PART 4 - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

- A.** Air distribution systems will be measured as per each complete in place, including all preparation, fixtures, accessories and incidentals.

4.2 PAYMENT

- A.** Payment for air distribution systems will be made at the Contract unit price for the quantities as specified above.

4.3 PAYMENT ITEMS

ITEM NO.	DESCRIPTION	UNIT
1580.011	AIR DISTRIBUTION	LS

END OF SECTION